AMENDMENTS TO THE CLAIMS

1. (Previously presented) A method for detecting a protrusion in a medical image, comprising:

segmenting a medical image;

calculating a distance map of the medical image;

calculating a gradient of the distance mapped medical image; and

processing the gradient to detect a protrusion in the medical image, wherein the gradient is processed by:

projecting a first plurality of rays from a location in the distance mapped medical image;

calculating a value for each of the first plurality of rays based on features of each of the first plurality of rays and the gradient of the distance mapped medical image;

summing and scaling the value of each of the first plurality of rays; and

detecting one of a sphere-like and polyp-like shape using the summed and scaled values of the first plurality of rays, wherein one of the sphere-like and polyp-like shapes is the protrusion.

2. (Original) The method of claim 1, further comprising:

acquiring the medical image.

3. (Original) The method of claim 2, wherein the medical image is acquired by one of a computed tomographic (CT), helical CT, x-ray, positron emission tomographic, fluoroscopic, ultrasound, and magnetic resonance (MR) imaging technique.

4. (Original) The method of claim 2, wherein the medical image is of an anatomical part.

5. (Canceled)

6. (Previously presented) The method of claim 1, wherein the processing step further comprises:

projecting a second plurality of rays from a location comprising an original distance value in the distance mapped medical image;

calculating an absolute value of a difference between a length of each of the second plurality of rays and a distance value at an end of each of the second plurality of rays, wherein the length of each of the second plurality of rays is a fraction of the original distance value from the location;

dividing a sum of the absolute value by the total number of the second plurality of rays; and

detecting one of a sphere-like and polyp-like shape using the division result, wherein one of the sphere-like and polyp-like shapes is the protrusion.

7. (Currently amended) The method of claim 1, wherein the processing step further comprises:

projecting a ~~third~~ second plurality of rays from a location comprising an original distance value in the distance mapped medical image;

determining a distance value for each of the ~~third~~ second plurality of rays that is a fraction of the original distance value from the location;

calculating a sphere-based response, wherein the sphere-based response is calculated by:

$$\frac{\sum_{i \in S}(d - l_i)}{T}$$

where d is the original distance value, l_i is the length of a ray i, T is a total number of the ~~third~~ second plurality of rays, and S is a set of the ~~third~~ second plurality of rays such that $l_i < d$; and

detecting the protrusion using the sphere-based response.

8. (Currently amended) The method of claim 1, wherein the processing step further comprises:

projecting a ~~fourth~~ second plurality of rays from a location comprising an original distance value in the distance mapped medical image;

determining a distance value for each of the ~~fourth~~ second plurality of rays that has a supplementary ray that has a distance value less than the original distance value;

calculating a hemisphere-based response, wherein the hemisphere-based response is calculated by:

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where d is the original distance value, l_i is the length of a ray i, T is a total number of the ~~fourth~~ second plurality of rays, and S is a set of the ~~fourth~~ second plurality of rays whose supplementary rays do not have a value less than the original distance value; and

detecting the protrusion using the hemisphere-based response.

9. (Currently amended) The method of claim 1, wherein the processing step further comprises:

projecting a ~~fifth~~ second plurality of rays from an edge of the distance mapped medical image, wherein the ~~fifth~~ second plurality of rays follow the steepest gradient; and

accumulating paths of the ~~fifth~~ second plurality of ~~projected~~ rays, wherein the accumulated paths form a response image for detecting the protrusion.

10. (Currently amended) The method of claim 1, wherein the processing step further comprises:

projecting a ~~sixth~~ second plurality of rays from a location comprising an original distance value in the distance mapped medical image;

determining a distance value for each of the ~~sixth~~ second plurality of rays that is a fraction of the original distance value from the location;

calculating a sphere-based response, wherein the sphere-based response is calculated by:

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where d is the original distance value, F is a fractional value between 0 and 1, d_i is the distance value at a point along one of the ~~sixth~~ second plurality of rays, l_i is the length of one of the ~~sixth~~ second plurality of rays at a point i, and T is the total number of points taken from i=0 to i=$F * d$;

calculating a gray-level difference of the distance mapped medical image, wherein the gray level difference is calculated by:

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where *rk* represents the sphere-based response for each ray *k*; and

detecting the protrusion using the gray-level difference.

11. (Original) The method of claim 1, wherein the protrusion is one of a nodule, lesion, polyp, pre-cancerous growth, and cancerous growth.

12. (Original) The method of claim 1, further comprising:

storing a list of one or more detected protrusions; and

filtering one or more false positives from the list, wherein one of the false positives is not one of a nodule, lesion, polyp, pre-cancerous growth, and cancerous growth.

13. (Currently amended) A system for detecting a protrusion in a medical image, comprising:

a memory device for storing [[a]] program code;

a processor in communication with the memory device, the processor operative with the program code to:

segment a medical image;

calculate a distance map of the medical image;

calculate a gradient of the distance mapped medical image; and

process the gradient to detect a protrusion in the medical image, wherein when processing the gradient, the processor is operative with the program code to:

project a first plurality of rays from a location in the distance mapped medical image;

calculate a value for each of the first plurality of rays based on features of each of the first plurality of rays and the gradient of the distance mapped medical image;

summing and scaling the value for each of the first plurality of rays; and

detecting one of a sphere-like and polyp-like shape using the summed and scaled values of the first plurality of rays, wherein one of the sphere-like and polyp-like shapes is the protrusion.

14. (Original) The system of claim 13, wherein the processor is further operative with the program code to:

acquire the medical image, wherein the medical image is of an anatomical part.

15. (Original) The system of claim 14, wherein the medical image is acquired by one of a computed tomographic (CT), helical CT, x-ray, positron emission tomographic, fluoroscopic, ultrasound, and magnetic resonance (MR) imaging technique.

16. (Canceled)

17. (Previously presented) The system of claim 13, wherein the processor is further operative with the program code when processing the gradient to:

project a second plurality of rays from a location comprising an original distance value in the distance mapped medical image;

calculate an absolute value of a difference between a length of each of the second plurality of rays and a distance value at an end of each of the second plurality of rays, wherein the length of each of the second plurality of rays is a fraction of the original distance value from the location;

divide a sum of the absolute value by the total number of the second plurality of rays; and

detect one of a sphere-like and polyp-like shape using the division result, wherein one of the sphere-like and polyp-like shapes is the protrusion.

18. (Currently amended) The system of claim 13, wherein the processor is further operative with the program code when processing the gradient to:

project a ~~third~~ second plurality of rays from a location comprising an original distance value in the distance mapped medical image;

determine a distance value for each of the ~~third~~ second plurality of rays that is a fraction of the original distance value from the location;

calculate a sphere-based response of the ~~third~~ second plurality of rays;

calculate a hemisphere-based response of the ~~third~~ second plurality of rays; and

detect the protrusion using the sphere and hemisphere-based responses.

19. (Currently amended) The system of claim 13, wherein the processor is further operative with the program code when processing the gradient to:

project a ~~fourth~~ second plurality of rays from an edge of the distance mapped medical image, wherein the ~~fourth~~ second plurality of rays follow the steepest gradient; and

accumulate paths of the ~~fourth~~ second plurality of rays, wherein the accumulated paths form a response image for detecting the protrusion.

20. (Currently amended) The system of claim 13, wherein the processor is further operative with the program code when processing the gradient to:

project a ~~fifth~~ second plurality of rays from a location comprising an original distance value in the distance mapped medical image;

determine a distance value for each of the ~~fifth~~ second plurality of rays that is a fraction of the original distance value from the location;

calculate a sphere-based response of the ~~fifth~~ second plurality of rays;

calculate a gray-level difference of the distance mapped medical image; and

detect the protrusion using the sphere-based response and the gray-level difference.

21. (Original) The system of claim 13, wherein the protrusion is one of a nodule, lesion, polyp, pre-cancerous growth, and cancerous growth.

22. (Original) The system of claim 13, wherein the processor is further operative with the program code when processing the gradient to:

store a list of one or more detected protrusions; and

filter one or more false positives from the list, wherein one or more of the false positives is not one of a nodule, lesion, polyp, pre-cancerous growth, and cancerous growth.

23. (Currently amended) A computer program product comprising a computer useable medium having computer program logic recorded thereon for detecting a protrusion in a medical image, the computer program logic comprising:

program code for segmenting a medical image;

program code for calculating a distance map of the medical image;

program code for calculating a gradient of the distance mapped medical image; and

program code for processing the gradient to detect a protrusion in the medical image, wherein the gradient is processed by:

projecting a plurality of rays from a location in the distance mapped medical image;

calculating a value for each of the plurality of rays based on features of each of the plurality of rays and the gradient of the distance mapped medical image;

summing and scaling the value of each of the plurality of rays; and

detecting one of a sphere-like and polyp-like shape using the summed and scaled values of the plurality of rays, wherein one of the sphere-like and polyp-like shapes is the protrusion. ;

~~program code for storing a list of one or more detected protrusions; and~~

~~program code for filtering one or more false positives from the list, wherein one or more of the false positives is not one of a nodule, lesion, polyp, pre-cancerous growth, and cancerous growth.~~

24. (Currently amended) The ~~system~~ computer program product of claim 23, further comprising:

program code for acquiring the medical image.

25. (Currently amended) The ~~system~~ computer program product of claim 24, wherein the image is acquired by one of a computed tomographic (CT), helical CT, x-ray, positron emission tomographic, fluoroscopic, ultrasound, and magnetic resonance (MR) imaging technique.

26. (Canceled)

27. (Currently amended) The ~~system~~ computer program product of claim 23, wherein the protrusion is one of a nodule, lesion, polyp, pre-cancerous growth, and cancerous growth.

28-31. (Canceled)

32. (Previously presented) A method for detecting a protrusion in a medical image, comprising:

segmenting a medical image;

calculating a distance map of the medical image;

calculating a gradient of the distance mapped medical image; and

processing the gradient to detect a protrusion in the medical image, wherein the gradient is processed by:

projecting a plurality of rays from a location comprising an original distance value in the distance mapped medical image;

calculating an absolute value of a difference between a length of each of the plurality of rays and a distance value at an end of each of the plurality of rays, wherein the length of each of the plurality of rays is a fraction of the original distance value from the location;

dividing a sum of the absolute value by the total number of the plurality of rays; and

detecting one of a sphere-like and polyp-like shape using the division result, wherein one of the sphere-like and polyp-like shapes is the protrusion.

33. (Currently amended) A method for detecting a protrusion in a medical image, comprising:

segmenting a medical image;

calculating a distance map of the medical image;

calculating a gradient of the distance mapped medical image; and

processing the gradient to detect a protrusion in the medical image, wherein the gradient is processed by using first, second or third techniques:

wherein the first technique includes:

projecting a plurality of rays from a location comprising an original distance value in the distance mapped medical image;

determining a distance value for each of the plurality of rays that is a fraction of the original distance value from the location;

calculating a ~~first~~ sphere-based response of the plurality of rays; and

detecting the protrusion using the ~~first~~ sphere-based response; ~~or~~

wherein the second technique includes:

projecting a plurality of rays from a location comprising an original distance value in the distance mapped medical image;

determining a distance value for each of the plurality of rays that is a fraction of the original distance value from the location;

calculating a ~~second~~ sphere-based response of the plurality of rays;

calculating a gray-level difference of the distance mapped medical image; and

detecting the protrusion using the gray-level difference; ~~or~~

wherein the third technique includes:

projecting a plurality of rays from a location comprising an original distance value in the distance mapped medical image;

determining a distance value for each of the plurality of rays that has a supplementary ray that has a distance value less than the original distance value;

calculating a hemisphere-based response of the plurality of rays; and

detecting the protrusion using the hemisphere-based response.